What is Claimed is:

1. A light emitting diode comprising:

a substrate having first and second opposing faces, that is transparent to optical radiation in a predetermined wavelength range and that is patterned to define, in cross-section, a plurality of pedestals that extend into the substrate from the first face towards the second face; and

a diode region on the second face that is configured to emit light in the predetermined wavelength range into the substrate that is transparent to optical radiation in the predetermined wavelength range, upon application of voltage across the diode region.

2. A light emitting diode according to Claim 1 further comprising:

a mounting support on the diode region, opposite the substrate that is transparent to optical radiation in the predetermined frequency range, the mounting support being configured to support the diode region such that the light that is emitted from the diode region into the substrate that is transparent to optical radiation in the predetermined wavelength range, is emitted from the plurality of pedestals, upon application of voltage across the diode region.

3. A light emitting diode according to Claim 1 further comprising:

a mounting support on the first face, opposite the diode region, the mounting support being configured to support the first face.

4. A light emitting diode according to Claim 2 further comprising:

a reflector between the mounting support and the diode region, that is configured to reflect light that is emitted from the diode region back into the diode region, through the substrate that is transparent to optical radiation in the predetermined wavelength range and from the plurality of pedestals, upon application of voltage across the diode region.

5. A light emitting diode according to Claim 3 further comprising:

a reflector between the mounting support and the first face, that is configured to reflect light that is emitted from the first face back into the substrate that is

transparent to optical radiation in the predetermined wavelength range, upon application of voltage across the diode region.

6. A light emitting diode according to Claim 4 further comprising:
a transparent electrode between the diode region and the reflector.

7. A light emitting diode according to Claim 5 further comprising a transparent electrode between the first face and the reflector.

8. A light emitting diode according to Claim 4 wherein the reflector comprises a layer of at least one reflective metal.

9. A light emitting diode according to Claim 6 wherein the transparent electrode comprises a layer of nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold.

10. A light emitting diode according to Claim 4 further comprising:
a barrier region between the reflector and the mounting support; and
a bonding region between the barrier region and the mounting support.

11. A light emitting diode according to Claim 5 further comprising:
a barrier region between the reflector and the mounting support; and
a bonding region between the barrier region and the mounting support.

12. A light emitting diode according to Claim 10 wherein the bonding region comprises gold, indium, solder and/or braze.

13. A light emitting diode according to Claim 11 wherein the bonding region comprises gold, indium, solder and/or braze.

14. A light emitting diode according to Claim 1 further comprising:
an optical element adjacent the first face, opposite the diode region.

15. A light emitting diode according to Claim 1 wherein the first face of the substrate includes therein at least one groove that defines, in cross-section, the plurality of pedestals in the substrate.

16. A light emitting diode according to Claim 15 wherein the pedestals are triangular pedestals.

17. A light emitting diode according to Claim 15 wherein the grooves include tapered and/or curved sidewalls.

18. A light emitting diode according to Claim 15 wherein the grooves include a beveled and/or curved floor.

19. A light emitting diode according to Claim 17 wherein the grooves include a beveled and/or curved floor.

20. A light emitting diode according to Claim 15 wherein the first and second faces of the substrate comprise square perimeters.

21. A light emitting diode according to Claim 15 wherein the first face of the substrate comprises a textured surface.

22. A light emitting diode according to Claim 1 wherein the first face of the substrate includes therein an array of via holes that defines, in cross-section, the plurality of pedestals in the substrate.

23. A light emitting diode according to Claim 22 wherein the via holes include tapered and/or curved sidewalls.

24. A light emitting diode according to Claim 22 wherein the via holes include a flat, beveled and/or curved floor.

25. A light emitting diode according to Claim 23 wherein the via holes include a flat, beveled and/or curved floor.

26. A light emitting diode according to Claim 22 wherein the first and second faces of the substrate comprise square perimeters.

27. A light emitting diode according to Claim 22 wherein the first face of the substrate comprises a textured surface.

28. A light emitting diode according to Claim 22 wherein the array of via holes comprises an array of tapered and/or curved via holes.

29. A light emitting diode according to Claim 1 wherein the diode region comprises a peripheral portion, at least one central portion that is enclosed by the peripheral portion and at least one emission region that is confined to within the at least one central portion and does not extend onto the peripheral portion.

30. A light emitting diode according to Claim 1 further comprising:

a plurality of emission regions on the diode region, a respective one of which is confined to within a respective one of the pedestals and does not extend beyond the respective one of the pedestals.

31. A light emitting diode according to Claim 15 further comprising:

a plurality of electrodes on the diode region, a respective one of which is confined to within a respective one of the pedestals and does not extend beyond the respective one of the pedestals.

32. A light emitting diode according to Claim 22 further comprising:

at least one electrode on the diode region that does not overlap the via holes.

33. A light emitting diode according to Claim 1, wherein the substrate comprises silicon carbide and wherein the diode region comprises gallium nitride.

34. A light emitting diode comprising:

a substrate having first and second opposing faces, the first face having smaller surface area than the second face; and

a diode region on the second face, the diode region including an emission region that is confined to within the smaller surface area of the first face.

35. A light emitting diodes according to Claim 34 wherein the emission region comprises a mesa.

36. A light emitting diode according to Claim 34 wherein the first face of the substrate comprises a textured surface.

37. A light emitting diode according to Claim 35 further comprising a transparent electrode on at least a portion of the mesa.

38. A light emitting diode according to Claim 34 wherein the substrate is a silicon carbide substrate that is transparent to optical radiation in a predetermined wavelength range and wherein the diode region is configured to emit light in the predetermined wavelength range.

39. A light emitting diode comprising:

a substrate having first and second opposing faces, the first face having smaller surface area than the second face;

a diode region on the second face; and

a mounting support on the diode region, opposite the substrate.

40. A light emitting diode according to Claim 39 wherein the substrate is transparent to optical radiation in a predetermined wavelength range and wherein the diode region is configured to emit light in the predetermined wavelength range into the substrate that is transparent to the optical radiation in the predetermined wavelength range, upon application of voltage across the diode region.

41. A light emitting diode according to Claim 40 wherein the mounting support is further configured to support the diode region such that the light that is emitted from the diode region into the substrate that is transparent to optical radiation in the predetermined wavelength range, is emitted from the first face, upon application of voltage across the diode region.

42. A light emitting diode according to Claim 41 further comprising:

a reflector between the mounting support and the diode region, that is configured to reflect light that is emitted from the diode region back into the diode region, through the substrate that is transparent to optical radiation in the predetermined wavelength range and from the first face, upon application of voltage across the diode region.

43. A light emitting diode according to Claim 42 further comprising:

a transparent electrode between the diode region and the reflector.

44. A light emitting diode according to Claim 42 further comprising:

a barrier region between the reflector and the mounting support; and

a bonding region between the barrier region and the mounting support.

45. A light emitting diode according to Claim 44 wherein the bonding region comprises gold, indium, solder and/or braze.

46. A light emitting diode comprising:

a substrate;

a diode region on the substrate; and

a contact structure on one of the substrate and the diode region, the contact structure comprising:

an ohmic and reflector region on the one of the substrate and the diode region;

a barrier region on the ohmic and reflector region, opposite the one of the substrate and the diode region; and

a bonding region on the barrier region, opposite the ohmic and reflector region.

47. A light emitting diode according to Claim 46 further comprising:

a mounting assembly on the bonding region, opposite the barrier region.

48. A light emitting diode according to Claim 46 wherein the ohmic and reflector region comprises:

a transparent ohmic layer on the one of the substrate and the diode region; and

a reflector on the transparent ohmic layer, opposite the one of the substrate and the diode region, wherein the barrier region is on the reflector.

49. A light emitting diode according to Claim 46 wherein the bonding region comprises gold, indium, solder and/or braze.

50. A light emitting diode according to Claim 48 wherein the transparent ohmic layer comprises a layer comprising of nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold that is sufficiently thin to be transparent to optical radiation in a predetermined wavelength range.

51. A light emitting diode according to Claim 50 wherein the transparent ohmic layer is between about 10Å and about 100Å thick.

52. A light emitting diode according to Claim 48 wherein the transparent ohmic layer comprises an indium tin oxide layer.

53. A light emitting diode according to Claim 48 wherein the transparent ohmic layer comprises a patterned transparent ohmic layer.

54. A light emitting diode according to Claim 48 wherein the patterned transparent ohmic layer comprises a grid and/or dot pattern.

55. A light emitting diode according to Claim 48 wherein the reflector comprises at least one layer of reflecting metal.

56. A light emitting diode according to Claim 46 wherein the ohmic and reflector region comprises a single layer comprising silver and/or aluminum.

57. A light emitting diode according to Claim 46 wherein the barrier region comprises nickel, nickel/vanadium and/or titanium/tungsten.

58. A light emitting diode according to Claim 46 wherein the bonding region comprises gold, indium, solder and/or braze.

59. A light emitting diode according to Claim 48:

wherein the transparent ohmic layer comprises a layer comprising nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold that is sufficiently thin to be transparent to optical radiation in a predetermined wavelength range;

wherein the reflector comprises at least one layer of reflecting metal;

wherein the barrier region comprises nickel, nickel/vanadium and/or titanium/tungsten; and

wherein the bonding region comprises gold, indium, solder and/or braze.

60. A light emitting diode according to Claim 59 wherein the transparent ohmic layer is between about 10Å and about 100Å thick.

61. A light emitting diode according to Claim 59 wherein the patterned transparent ohmic layer comprises a grid and/or dot pattern.

62. A light emitting diode comprising:

a substrate having first and second opposing faces, the first face having smaller surface area than the second face;

a diode region on the second face;

a first ohmic layer on the first face opposite the diode region;

an adhesion layer on the first ohmic layer opposite the substrate;

a first barrier layer on the adhesion layer opposite the first ohmic layer;

a first bonding layer on the first barrier layer opposite the adhesion layer;

a second ohmic layer on the diode region opposite the substrate;

a reflector layer on the second ohmic layer, opposite the diode region;

a second barrier layer on the reflector layer opposite the second ohmic layer; and

a second bonding layer on the second barrier layer opposite the reflector layer.

63. A light emitting diode according to Claim 62 further comprising a mounting support on the second bonding layer opposite the second barrier layer.

64. A light emitting diode according to Claim 62 wherein the second ohmic layer comprises a second ohmic and reflector layer.

65. A light emitting diode according to Claim 62 wherein the first ohmic layer comprises a reflective metal.

66. A light emitting diode according to Claim 62 wherein the adhesion layer comprises titanium.

67. A light emitting diode according to Claim 62 wherein the first barrier layer comprises platinum.

68. A light emitting diode according to Claim 62 wherein the first bonding layer comprises gold.

69. A light emitting diode according to Claim 62 wherein the second ohmic layer comprises nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold.

70. A light emitting diode according to Claim 62 wherein the reflector layer comprises silver and/or aluminum.

71. A light emitting diode according to Claim 62 wherein the second barrier layer comprises nickel, nickel/vanadium and/or titanium/tungsten.

72. A light emitting diode according to Claim 62 wherein the second bonding layer comprises gold, indium, solder and/or braze.

73. A light emitting diode according to Claim 62 wherein the first ohmic layer, the adhesion layer, the first barrier layer and the first bonding layer each

comprises a central portion and at least one finger that extends from the central portion.

74. A light emitting diode comprising:

a substrate having first and second opposing faces, the first face having smaller surface area than the second face;

a diode region on the second face;

a first layer comprising silver and/or aluminum on the first face opposite the diode region;

a second layer comprising titanium on the first layer opposite the substrate;

a third layer comprising platinum on the second layer opposite the first layer;

a fourth layer comprising gold on the third layer opposite the second layer;

a fifth layer comprising nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold on the diode region opposite the substrate;

a sixth layer comprising silver and/or aluminum on the fifth layer, opposite the diode region;

a seventh layer comprising nickel, nickel/vanadium and/or titanium/tungsten on the sixth layer opposite the fifth layer; and

a eighth layer comprising gold, indium, solder and/or braze on the seventh layer opposite the sixth layer.

75. A light emitting diode according to Claim 74 further comprising a mounting support on the eighth layer opposite the seventh layer.

76. A light emitting diode comprising:

a substrate having first and second opposing faces, the first face having smaller surface area than the second face;

a diode region on the second face;

a first adhesion layer on the first face opposite the diode region;

a first barrier layer on the first adhesion layer opposite the substrate;

a first bonding layer on the first barrier layer opposite the first adhesion layer;

an ohmic layer on the diode region opposite the substrate;

a reflector layer on the ohmic layer opposite the diode region;

a second adhesion layer on the reflector layer opposite the ohmic layer;

a second barrier layer on the second adhesion layer opposite the reflector layer; and

a second bonding layer on the second barrier layer opposite the second adhesion layer.

77. A light emitting diode according to Claim 76 further comprising a mounting support on the first bonding layer opposite the first barrier layer.

78. A light emitting diode according to Claim 76 wherein the ohmic layer comprises an ohmic and reflector layer.

79. A light emitting diode according to Claim 76 wherein the first adhesion layer comprises titanium.

80. A light emitting diode according to Claim 76 wherein the first barrier layer comprises platinum.

81. A light emitting diode according to Claim 76 wherein the first bonding layer comprises gold.

82. A light emitting diode according to Claim 76 wherein the ohmic layer comprises nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold.

83. A light emitting diode according to Claim 76 wherein the reflector layer comprises silver and/or aluminum.

84. A light emitting diode according to Claim 76 wherein the second adhesion layer comprises titanium.

85. A light emitting diode according to Claim 76 wherein the second barrier layer comprises platinum.

86. A light emitting diode according to Claim 76 wherein the second bonding layer comprises gold.

87. A light emitting diode comprising:

a substrate having first and second opposing faces, the first face having smaller surface area than the second face;

a diode region on the second face;

a first layer comprising titanium on the first face opposite the diode region;

a second layer comprising platinum on the first layer opposite the substrate;

a third layer comprising gold on the second layer opposite the first layer;

a fourth layer comprising nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold on the diode region opposite the substrate;

a fifth layer comprising silver and/or aluminum on the fourth layer opposite the diode region;

a sixth layer comprising titanium on the fifth layer opposite the fourth layer;

a seventh layer comprising platinum on the sixth layer opposite the fifth layer; and

an eighth layer comprising gold on the seventh layer opposite the sixth layer.

88. A light emitting diode according to Claim 88 further comprising a mounting support on the third layer opposite the second layer.

89. A light emitting diode comprising:

a compensated, colorless silicon carbide substrate having first and second opposing faces; and

a gallium nitride-based diode region on the second face that is configured to emit light into the substrate upon application of voltage across the diode region.

90. A light emitting diode according to Claim 89 further comprising:

a mounting support on the diode region, opposite the substrate, the mounting support being configured to support the diode region such that the light that is emitted from the diode region into the substrate, is emitted from the substrate, upon application of voltage across the diode region.

91. A light emitting diode according to Claim 89 further comprising:

a mounting support on the first face, opposite the diode region, the mounting support being configured to support the first face.

92. A light emitting diode according to Claim 90 further comprising:

a reflector between the mounting support and the diode region, that is configured to reflect light that is emitted from the diode region back into the diode region, through the substrate and from the substrate, upon application of voltage across the diode region.

93. A light emitting diode according to Claim 91 further comprising:

a reflector between the mounting support and the first face, that is configured to reflect light that is emitted from the first face back into the substrate, upon application of voltage across the diode region.

94. A light emitting diode according to Claim 92 further comprising:

a transparent electrode between the diode region and the reflector.

95. A light emitting diode according to Claim 93 further comprising a transparent electrode between the first face and the reflector.

96. A light emitting diode according to Claim 92 wherein the reflector comprises a layer of at least one reflective metal.

97. A light emitting diode according to Claim 94 wherein the transparent electrode comprises a layer of nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold.

98. A light emitting diode according to Claim 92 further comprising:

a barrier region between the reflector and the mounting support; and

a bonding region between the barrier region and the mounting support.

99. A light emitting diode according to Claim 93 further comprising:

a barrier region between the reflector and the mounting support; and
a bonding region between the barrier region and the mounting support.

100. A light emitting diode according to Claim 98 wherein the bonding region comprises gold, indium, solder and/or braze.

101. A light emitting diode according to Claim 99 wherein the bonding region comprises gold, indium, solder and/or braze.

102. A light emitting diode according to Claim 89 further comprising:
an optical element adjacent the first face, opposite the diode region.

103. A light emitting diode according to Claim 89 wherein the first face of the substrate includes therein at least one groove that defines, in cross-section, a plurality of pedestals that extend into the substrate from the first face towards the second face.

104. A light emitting diode according to Claim 103 wherein the pedestals are triangular pedestals.

105. A light emitting diode according to Claim 103 wherein the grooves include tapered and/or curved sidewalls.

106. A light emitting diode according to Claim 103 wherein the grooves include a beveled and/or curved floor.

107. A light emitting diode according to Claim 105 wherein the grooves include a beveled and/or curved floor.

108. A light emitting diode according to Claim 103 wherein the first and second faces of the substrate comprise square perimeters.

109. A light emitting diode according to Claim 103 wherein the first face of the substrate comprises a textured surface.

110. A light emitting diode according to Claim 89 wherein the first face of the substrate includes therein an array of via holes that defines, in cross-section, a plurality of pedestals that extend into the substrate from the first face towards the second face.

111. A light emitting diode according to Claim 110 wherein the via holes include tapered and/or curved sidewalls.

112. A light emitting diode according to Claim 110 wherein the via holes include a flat, beveled and/or curved floor.

113. A light emitting diode according to Claim 111 wherein the via holes include a flat, beveled and/or curved floor.

114. A light emitting diode according to Claim 110 wherein the first and second faces of the substrate comprise square perimeters.

115. A light emitting diode according to Claim 110 wherein the first face of the substrate comprises a textured surface.

116. A light emitting diode according to Claim 110 wherein the array of via holes comprises an array of tapered and/or curved via holes.

117. A light emitting diode according to Claim 89 wherein the diode region comprises a peripheral portion, at least one central portion that is enclosed by the peripheral portion and at least one emission region that is confined to within the at least one central portion and does not extend onto the peripheral portion.

118. A light emitting diode according to Claim 89 further comprising:

a plurality of emission regions on the diode region, a respective one of which is confined to within a respective one of the pedestals and does not extend beyond the respective one of the pedestals.

119. A light emitting diode according to Claim 103 further comprising:

a plurality of electrodes on the diode region, a respective one of which is confined to within a respective one of the pedestals and does not extend beyond the respective one of the pedestals.

120. A light emitting diode according to Claim 110 further comprising:

at least one electrode on the diode region that does not overlap the via holes.

121. A light emitting diode comprising:

a substrate having first and second opposing faces;

a gallium nitride-based diode region on the second face that is configured to emit light into the substrate, upon application of voltage across the diode region; and

means for extracting from the substrate, at least some of the light that is emitted into the substrate by the diode region.

122. A light emitting diode according to Claim 121 wherein the substrate comprises silicon carbide and wherein the means for extracting comprises means for compensating dopants in the silicon carbide to provide a colorless silicon carbide substrate.

123. A light emitting diode according to Claim 121 wherein the means for extracting comprises means for patterning the substrate to define, in cross section, a plurality of pedestals that extend into the substrate from the first face towards the second face.

124. A method of manufacturing a light emitting diode comprising:

forming a diode region that is configured to emit light in a predetermined wavelength range on a second face of a substrate having first and second opposing faces and that is transparent to the optical radiation in the predetermined wavelength range; and

patterning the substrate to define, in cross-section, a plurality of pedestals that extend into the substrate from the first face towards the second face.

125. A method according to Claim 124 further comprising:

mounting the diode region onto a mounting support that is configured to support the diode region such that the light that is emitted from the diode region into the substrate that is transparent to optical radiation in the predetermined wavelength range, is emitted from the plurality of pedestals, upon application of voltage across the diode region.

126. A method according to Claim 124 further comprising:

mounting the first face onto a mounting support.

127. A method according to Claim 125:

wherein the mounting is preceded by forming a reflector on the diode region that is on the second face of the substrate having the first and the second opposing faces, such that the reflector is configured to reflect light that is emitted from the diode region back into the diode region, through the substrate and from the plurality of pedestals, upon application of voltage across the diode region; and

wherein the mounting comprises mounting the reflector on the mounting support that is configured to support the diode region such that the light that is emitted from the diode region into the substrate that is transparent to optical radiation in the predetermined wavelength range, is emitted from the plurality of pedestals, upon application of voltage across the diode region.

128. A method according to Claim 127:

wherein the forming a reflector is preceded by forming a transparent electrode on the diode region opposite the substrate: and

wherein the forming a reflector comprises forming a reflector on the transparent electrode, opposite the diode region, such that the reflector is configured to reflect light that is emitted from the diode region back into the diode region, through the substrate and from the plurality of pedestals, upon application of voltage across the diode region.

129. A method according to Claim 127 wherein the reflector comprises a layer of at least one reflective metal.

130. A method according to Claim 128 wherein the transparent electrode comprises a layer of nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold.

131. A method according to Claim 127 wherein the mounting is preceded by:

forming a barrier region on the reflector; and

forming a bonding region on the barrier region; and

wherein the mounting comprises bonding the bonding region to the mounting support.

132. A method according to Claim 131 wherein the bonding region comprises gold, indium, solder and/or braze.

133. A method according to Claim 131 wherein the mounting support comprises a heat sink.

134. A method according to Claim 124 further comprising:

mounting an optical element adjacent the first face, opposite the diode region.

135. A method according to Claim 124 wherein the patterning comprises:

forming at least one groove into the first face of the substrate to define the plurality of pedestals in the substrate.

136. A method according to Claim 135 wherein the pedestals are triangular pedestals.

137. A method according to Claim 135 wherein the grooves include tapered and/or curved sidewalls.

138. A method according to Claim 135 wherein the grooves include a beveled and/or curved floor.

139. A method according to Claim 137 wherein the grooves include a beveled and/or curved floor.

140. A method according to Claim 135 further comprising:

texturing the first face of the substrate.

141. A method according to Claim 124 wherein the patterning comprises:

reactive ion etching an array of via holes into the first face of the silicon carbide substrate.

142. A method according to Claim 141 wherein the via holes include tapered and/or curved sidewalls.

143. A method according to Claim 141 wherein the via holes include a flat, beveled and/or curved floor.

144. A method according to Claim 142 wherein the via holes include a flat, beveled and/or curved floor.

145. A method according to Claim 141 further comprising:

texturing the first face.

146. A method according to Claim 124 wherein the diode region includes a peripheral portion and at least one central portion that is enclosed by the peripheral portion, the method further comprising:

forming at least one emission region in the diode region, that is confined to within the at least one central portion and does not extend onto the peripheral portion.

147. A method according to Claim 135 further comprising:

forming a plurality of electrodes on the diode region, a respective one of which is confined to within a respective one of the pedestals and does not extend beyond the respective one of the pedestals.

148. A method according to Claim 141 further comprising:

forming an electrode on the diode region that does not overlap the via holes.